

Poster presentation

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## Biophysical cortical column model for optical signal analysis

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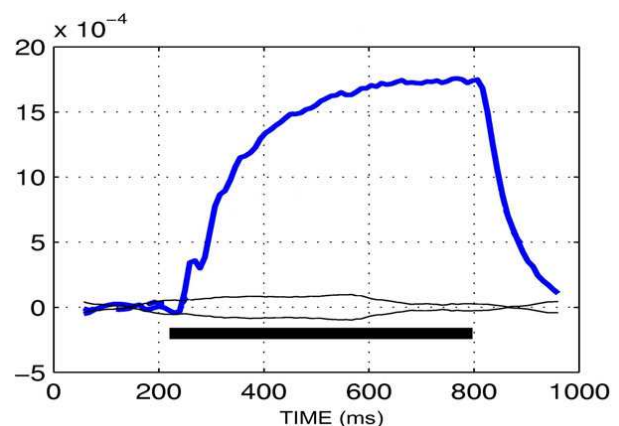
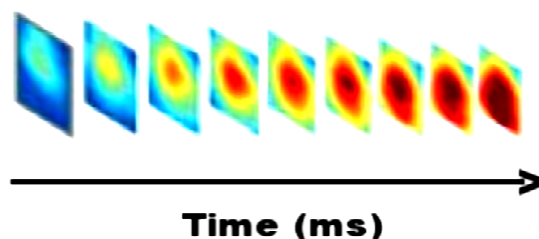
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We propose a biological cortical column model, at a mesoscopic scale, in order to explain and interpret biological sources of voltage-sensitive dye imaging signal. The mesoscopic scale, corresponding to a micro-column, is about 50  $\mu\text{m}$ . The proposed model takes into account biological and electrical neural parameters of the laminar cortical layers. Thus we choose a model based on a cortical micro-circuit, whose synaptic connections are made only between six specific populations of neurons, excitatory and inhibitory neurons in three main layers, following [1]

and [2]. For each neuron, we use a conductance-based single compartment Hodgkin-Huxley neuron model [3].

We claim that our model will reproduce qualitatively the same results as the optical imaging signal based on voltage-sensitive dyes, which represents the summed intracellular membrane potential changes of all the neuronal elements at a given cortical site [4]. Furthermore, this voltage-sensitive dye imaging has a submillisecond temporal resolution that allows us to explore the dynamics of cortical



**Figure 1**

**Voltage-sensitive dye optical imaging allows a real-time visualization of large neuron populations activity.** Left: Temporal evolution of the dye optical signal. Right: Response curve in one position of the map, same time scale.

cal processing. An example of data of V1 dye-signal in a cat, after a visual local stimulation, is shown in Figure 1. Therefore, the temporal dynamics of the measured signal will be carefully studied as being of primary interest for the proposed model identification.

## Methods

We use the NEURON software to implement our cortical column model of about  $10^2$  neurons and run simulations. Larger-scale models are going to be developed with the event-based simulator MVASPIKE, or with a specific optimal software, thanks to PyNN.

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